The Internet and the Future of Social Science Research

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ABSTRACT

This chapter considers the impact that the Internet and related communications technologies (IRCT) will have on the range of possibilities and prospects for new generations of social scientists. Contemporary and future developments will advance the scale of research activities that are feasible and the kinds of subjects that are 'researchable'. The opportunities and challenges posed by the Internet and related communications technologies will be driven both by changes in societies and advances in our methods, increasing capacity to do some of the same things either better or on a larger scale, and to do new things in relation to data collection, analysis and dissemination. Amongst the issues the chapter considers are the likely implications for new kinds of research relationship, ways of dealing with increasingly vast amounts of potential data, responses to associated ethical issues, the potential for social science use of 'smart' technological assistants, and what further technological changes may be on the way. A useful heuristic is the typology of probable, possible, improbable and (probably) impossible applications of IRCT over the coming years. The chapter considers candidates for each category, their relationship to present practice, and the kinds of skill that are likely to be required on the part of new generations of social science researchers.

INTRODUCTION

History doesn't repeat itself, but it sure rhymes.

Attributed to Mark Twain

New generations of social scientists face a different range of possibilities and prospects in their careers than most academics currently in post. The Internet and related communications technologies (IRCT) will play a major role in these differences. The Internet will greatly impact social scientists' practice, advancing the scale of activities rendered feasible, significant changes in the kinds of research carried out and, importantly, the kinds of subject deemed 'researchable'. Most importantly, IRCT have already become social infrastructure which people are using to create new social phenomena, and thus creating, in part, future objects of study for social scientists.

People are using the Internet and related communications technologies to change the world around us, creating circumstances that

change so quickly, over such large areas, that apparently continual adaptation – technological, social and cultural – is necessary. This trend will expand apace. The opportunities for social scientists will be driven both by changes in societies and advances in our research methods. We will do some of the same things better, or at least on a larger scale. We will be able to carry out hitherto unimagined activities relating to data collection, analysis and dissemination. Concurrently, many of the social and cultural forms that emerge will create situations we are ill equipped to understand. We will require new capabilities to enable social scientists to operationalise some well-established conceptual and terminological descriptions and understandings. We must also develop new theoretical concepts and vocabularies.

How will we deal with new kinds of relationship? What do we do with the vast amounts of data that become available from technologically enhanced observation and participation? How will the formidable ethical issues be addressed? How do we study social and cultural phenomena that may exist for a few years, months or only weeks? How do we adapt to a dependence on 'smart' technological assistants in our research? How will we be able to disseminate our results, not just in static form but in formats that directly interact with potential users? What further technological change can we expect? Perhaps the best way to predict the short-term future (3–7 years) of the impact of IRCT on social science research is simply to look at what a minority of computer and network-savvy individuals are able to do now. Dow in 1992 accurately predicted much of the development of computing in mainstream anthropology, simply by looking at what the minority were doing at the time. The contributions to this volume will serve as a model for the short-term development of IRCT-related research.

Predicting the longer-term future (7–20 years) is more problematic. Today, visions and trends are evident which, if continued, will lead to identifiable future practices. However, any number of factors can interfere with current trends and derail the best-laid futurology. One can, nevertheless, still differentiate between probable, possible, improbable and (probably) impossible applications of IRCT over the coming twenty years. Although our grasp of future history might be weak, by focusing on the development of capabilities we can get a handle on what tools and resources people (and researchers) have available to build our future.

This chapter discusses how new or expanded capabilities emergent from IRCT may contribute to changing social science research, particularly how research topics, methods and capabilities might change with increasing integration of IRCT into the daily social lives of most people in developed and developing societies. We have not limited ourselves to online research, because we believe that firm distinctions between online and offline research is a present phenomenon, and that online research will rapidly become one of the many different contexts within which research is carried out – not the odd one out. However, we expect all social science research to change, for the very reasons that online research will become accepted and ordinary as online social phenomena become integrated into wider social and cultural life.

There are thus two broad themes: new social formations, phenomena and conditions that arise because of access to IRCT technologies; and new methods that become available to carry out social research using IRCT technologies. These two themes will, of course, co-occur, and will quickly converge.

We can relate only to capabilities that may underlie research methods, not specific future methods. We discuss some of the major new capabilities which are likely and offer some examples. Similarly, we do not make specific predictions of wider social change, but rather new social capabilities. We discuss virtual groups, but for the most part we shall leave predictions about specific future social and cultural development to our, and the reader's, science fiction avatars.

CHANGE AND CHANGES TO IRCT TECHNOLOGIES

Although there is a tendency to focus on technology as a material process, technology has also been described as a process of social and cultural instantiations of ideational innovation (Fischer, 2004; 2006a) or, more succinctly, the adaptive transformation of ideas into practice. We view technology as anything that people use to extend or expand their capabilities materially, directly or indirectly (following Hall, 1976).

In this context, what are recognised as technologies result from those ideas whose instantiation have social and cultural histories (they were successful), which in turn create a sense of inevitability for their future. In discussing the future development of IRCT and the impacts on social research we have to project a history that does not yet exist, and thus must ultimately fail. The development of material futures is never linear. Technological development, human extensions (Hall, 1976), are formed by adaptive processes. As human culture transforms the material world (Fischer, 2006a), new possibilities emerge for instantiation of our prior symbolic constructions. Core cultural ideas will also change over time, but much more slowly than how people instantiate these into the world.

We are not dealing with some process of evolution by natural selection that lacks teleology; many of the visions instantiated using the Internet considerably preceded the Internet itself (e.g. Bush, 1945). Most of the current development of IRCT instantiates broad visions (fantasies?) from the mid-twentieth century. However, the material form that manifests these visions, the social and cultural formations and uses people make of the (partial) results and interactions of these visions, do not have such a long history. So, starting from now, we know certain kinds of things about technologies of the future–*what* some of the capabilities will be, but not the *forms* these will take, nor the outcomes of their manifestation and uses.

Much of what we discuss will not sound very futuristic. Indeed, to a few readers it will appear mundane or fundamental. There is a very good reason for that, since we are looking only over the next twenty years. Although people often perceive that technologies arrive and rapidly change the world around us,[1] our experience so far is that it takes at least 15–20 years (aka the 'Fischer fifteen-year rule') for new capabilities to become pervasive following their first entry as a deliverable technology. Researchers are a bit more precocious than this, and for specialists with technical skills the period is more like three to seven years, and specialists without technical skills up to ten. But for a capability to become pervasive in the research community as a whole, the period is very similar to the general public. Much of what we discuss is partially achievable now, but is often still dependent on current and future research for continued development. So that covers the next twenty years quite well.

Although it is possible that currently unknown *fundamental* 'new technologies' may emerge over this period, it is unlikely that those would have a great impact for at least ten or twenty years afterwards. For example, microcomputer technology was first delivered by Intel as a commercial technology in 1968, and gained mass acceptance in the form of microcomputers in the period sometime between 1983 and 1985. E-mail was first introduced on the Arpanet around 1972–3, but did not achieve mass acceptance in universities until around 1988. Telnet (for interactive sessions between networked computers) was also introduced in 1972–3 and FTP (for file transfers between networked computers) in 1973. The 'web' was introduced in 1991 between a few institutions, expanded slowly during 1993–4, and began to become a phenomenon from mid-1994 (after the release of Windows 95) – nearly 22 years after FTP (whose functionality it incorporates), and 18 years after the first public online information services (Leiner et al., 2007).

However, an argument can be made that as the World Wide Web and the Internet become pervasive in the developed nations, and are increasingly used in emerging nations, the capacity for digital technologies influencing

people's lives using IRCT may well break this principle with respect to 'virtual' objects and, as we shall suggest later, a much greater range of more material objects as well. If so, we suggest it will be due to changes in social institutions, not material technological processes.

It used to be that technologies had to be developed, honed into a variety of applications, and then people had to be convinced to use or take up the technology. While these steps are still part of the process, much of the front-end social activity required to disseminate a technology has now been reduced in influence. A technology can be brought to 'market' very quickly, in a range of forms, and can succeed through what is now called 'viral marketing'.

Any increase in IRCT-mediated ('online') social relations will result in social change by definition. A principal topic of this volume is just how we, as social scientists, should go about the study of these relationships. For instance, some researchers have been attracted to online research because of the appearance of new virtual communities; others have been attracted to the use of virtual panels and surveys to study more traditional social institutions and formations.

The use of technology in social science research is hardly new (or uncontested). But IRCT supports many new opportunities and capabilities with respect to data collection and documentation, theory and analysis. Aspects of the research process that IRCT can most greatly impact are:

- Communication – the capacity to gather, disseminate and exchange information. This can include data collection, whether through direct contact with people or by sensors (cameras, GPS, heart-rate monitors), collaboration with researched colleagues or research colleagues, and publication of the outcomes of research.
- Representation – the capacity to describe, model and visualise information: how information is aggregated, visualised, described, modelled, transcribed, presented, transformed, reduced, expanded and interrelated.
- Storage – the capacity to retain and retrieve information: the form, medium and availability of retained information (most often representations).

These aspects are interrelated in any kind of research workflow, whatever its technological base. For example, the data collected is recorded (stored) as representations. Analysis generally consists of creating new representations from old, retrieving (from storage), and communicating the results.

Computing has enhanced the scope of each of these processes in research and, to an extent, their integration, particularly representation and storage. Overall, computer-based methods have simply enhanced previous approaches without introducing new ones. However, even these quantitative changes (doing more, more quickly and more pervasively) have had important impacts.

COMMUNICATIONS

The development of different methods for communicating complex symbolic messages did not, of course, begin with the Internet. Leaving aside the history of generative language development, we can be reasonably sure that writing made new kinds of social organisation possible, even if the strongest forms of this claim have been questioned, for example, Goody and Watt (1963). Eisenstein (1979) has posited similar radical changes as a consequence of the printing press (see also Zeitlyn, 2001).

Arguably, the advent of photography, film and television has also had a profound impact on the ways people are able to record, transmit and use information which cannot simply be subsumed within the more widely discussed areas of writing and printing. Telephony and facsimile technologies have changed the way commerce can happen. Each technological development in its turn enables new ways of forming and maintaining social relationships, while simultaneously rendering some types of social relationship either less critical or obsolete. Internet communication in the form of e-mail has transformed the ways in which social scientists exchange information and develop friendships and collaborations. The gamut of file transfer protocols and resulting services has made it possible to

share immensely large datasets of disparate data types at relatively low cost (both financially and in terms of time). The vast expansion of audit procedures accompanying the integration of IRCT is itself evidence of the effectiveness of collating, sorting and searching procedures for use with different data types.

One of the obvious growth areas in Internet communications involves the transmission of real time visual data. This presently may take the form of video conferencing, or the positioning of a camera somewhere and making available live video feeds of events on the Internet. The main trend of developing capabilities over the next two decades in research communication will be pervasiveness and presence. 'Pervasiveness' simply refers to how many contexts a capability is available in. The more contexts, the more possibilities for use of the capabilities available. 'Presence' simply means that which we bring to a situation and context. With respect to communications, it refers to communicating presence, bringing more of ourselves and the others we interact with into context. The telephone was a great stride in presence, and found its way into the research process, sometimes controversially (at least where sampling was an issue). Although available for some years, video communications for research has been rather more limited, particularly in the social sciences. While some research collaborations have benefited, until recently the general quality, difficulty and expense of setting up sessions has limited this benefit. Now communications infrastructure, technical innovation and software design make limited video-based communication pervasively possible.

But while video does increase our presence, it only incrementally increases the effectiveness of an audio-only channel, and can actually distract unless the image is relatively detailed and continuous. Communications whiteboards, where writing, drawing and images can be exchanged, are often more effective in communicating presence. In other words, 'presence' is our ability to exert influence at the other end of our communications link.

We can expect much more development of presence in the short and long terms, just extrapolating from present capabilities, and even in the following ones, which exist in embryonic form. Improvements in sensors will make possible the transmission not only of sound and image, but heat, odour and taste. Advances in robotics will create devices that we can operate remotely for demonstration, or even the use of remote equipment. We will be able to meet in simulated environments, perhaps represented by avatars (as in Second Life), and increasingly by simulated images of ourselves operating with others in simulated space. However, interactions will not be limited to the simulated space; we can link actions that we and others take in that space to impacts in our own space. Using even current capabilities in 3-D image reproduction, these collaborations or panels will communicate a great deal of presence with a much thinner simulated meeting space. And the effective transmission of material objects over communications channels is likely to appear to some extent, as instructions are sent to devices that can manufacture objects (somewhat like a 3-D printer). Although still in early development, Access Grid e-science technology (Fielding and Macintyre, 2006) has or aims to support most of the capabilities above.

One question that arises as a result of the increasing use of video-presence communication via the Internet is the extent to which it might replace normal face-to-face (or 'face-time') interaction. Those who have participated in a video conference as part of their research can almost certainly attest to a vague scepticism about the ability of such formats to genuinely replace more conventional forms of meetings; nevertheless, as bandwidth, memory and CPU obstacles recede and the cost of air travel (in environmental as well as financial terms) increases, it is not controversial to suggest that organisations will increasingly encourage researchers to make use of video communications where possible.

Even more than video conferencing, however, what is likely to transform the way social scientists carry out their work is the pervasiveness and the complexity of the communication. The spread of mobile communication devices has been astounding and these now have substantial capacity for complex communication including file transfer, video, audio in both synchronous and asynchronous modes. Moreover, much of the communication does not happen between two people directly, but with some form of software agent acting as mediator. We do not mean that in the sense that a series of software tools and protocols enable the communication to take place but, rather more literally, that a software agent is actually engaging in the communication. At the moment we can see this in the form of electronic calendars, which remind people of meetings, or Amazon-style user-generated pages recommending further purchases based on previous browsing history. Software will continue this trend in simulating humans, and while the Turing test for AI may be irrelevant, we suggest that the only real way humans will be able to differentiate such communication between machines or people is likely to be linked to the inefficiency and delayed response time of the human. We anticipate three relevant types of change:

1. changes to the profile of potential collaborative partners;
2. changes in the ways certain kinds of 'field' research may be conducted;
3. changes in the ways in which the mundane aspects of being a member of an institution are acted out.

E-mail in conjunction with affordable air travel, snail mail and the telephone have already made it possible for geographically distributed teams of researchers to coordinate their efforts and effectively create something akin to research centres without a physical location. In 1995 Zeitlyn created a Virtual Institute of Mambila Studies, which brings together resources relevant to the international pool of Mambila specialists.

The technical problems of rolling out such pervasive complex communication, we suggest, are being resolved as we write, and within the near future there will be no more plausible technical arguments against using such communication than there currently are against using e-mail or the telephone (which is to say, there will probably always be some problems, but most users can make it 'work' without much technical expertise). We would suggest that the social constraints, on the other hand, are more entrenched and revolve around the ways in which researchers actually collaborate, as opposed to the way much project-management software envisions collaboration and teamwork. Nevertheless, as earlier communication technologies changed the kinds of social organisation considered feasible or possible, we suggest that pervasive complex communication is on the verge of doing the same.

The changes to expanding the 'field' seem to us inevitable. Webcams have become a ubiquitous feature of the WWW and constitute a legitimate area of study for the social sciences. The use of streaming video changes the way that primary field data may be disseminated and made available for secondary research. To be sure, there are a number of problems with relying on someone else's video. Even multiple cameras are highly restrictive in what gets shown. Within anthropology it is almost certainly the case that departments will require an extended period of participant observation by all doctoral candidates for the foreseeable future. In the postdoctoral career it is rare for researchers to have the luxury of additional extended periods in the field, and while this poses no particular problem for researchers returning to the primary field site, it can be frustrating when trying to develop new field sites for research. Short-term field research, combined with judicious use of video-presence in partnership with local academics and informants, potentially offers an attractive way of generating data and increasing the reliability of those data. Experiments with distributing still cameras and film equipment to informants have proven

intriguing (though it is not always clear if the efforts have been successful), and with the increased use of digital cameras around the world (particularly among the urban middle and upper classes across South and East Asia) it becomes feasible to design a research project which explicitly makes use of video (possibly even video conferencing) for primary data collection. To be sure, all of the problems inherent in developing trust and closeness with collaborators are present when attempting to use video conferencing with informants, but as such technologies become more pervasive we expect there to be corresponding shifts in the ways that close relationships may be formed.

To summarise, much of the 'future' of pervasive communication is in fact the present! We have suggested that little new technology per se is required to achieve the ubiquitous disparate communication we believe is emerging. However, new technological developments will enhance many aspects of this communication and widen the range of people able to capitalise on it. Further, we suggest that a number of things are relatively certain about communication:

1. Collaboration will rely on pervasive multi-format interactions, all of which are possible today, but which will be simpler, more integrated and more robust.
2. As such communication becomes more pervasive, the objections about impersonality or partiality will recede. In other words, people will develop new ways of inferring closeness, intimacy and trust through online interaction.
3. Pervasive online communication, like simple e-mail and multimedia presentation software before it, will become part of the baseline set of software packages that all social scientists will be assumed to have mastered.

REPRESENTATION

When collecting data and documenting human practices, institutions, languages, societies and cultures, social science researchers directly incorporate new technologies of representation, both in a primary sense and with respect to data derived from what people create using the technologies (new and old) at their disposal. Data is derived from and is represented by fieldnotes, sketches, transcription, photography, telephones, radio, audio recording, film and video, and – increasingly common these days – multimedia distributed on CD/DVD discs and over the Internet (Macfarlane, 1987; Farnell, 1995; Biella, 1997; Fischer and Zeitlyn, 1999).

Researchers are familiar with recording aural and visual data as part of data collection. These recordings can be used reflexively in the field to elicit detailed descriptions, to interpret and also to disseminate knowledge (they can also be used to train new researchers). This has become more common in recent years. However, the advent of hypertext compilations has given this type of data feedback far more power and interest. The ability to interrelate components of both data sources and data representations, with the addition of links between segments of different media, has led increasingly to researchers recording knowledge about the interoperation of the people, processes and objects depicted by the media, both their own and knowledge elicited from their local research collaborators on the ground (Biella, 2004; Ruby, 2005).

Computer representations have generally been considered by most people as virtual objects – abstract representations of real things. Increasingly, computer representations are achieving first-class object status, in the sense that people can manipulate them precisely as they would manipulate 'real' objects. Starting with videogame players, and now extending to users of mobile technology such as the iPhone, configurable objects are becoming more and more common in people's lives, mediating interactions between people, and thus becoming as much objects of social research as any other human artefact.

The development of small computers and improvements in ease of authoring complex interactive multimedia makes for the capability of recording physical interaction with the embedded multimedia object available in the field (Zeitlyn and Fischer, 1999; Bagg et al., 2006). The availability of

embedded computers and computer sensors will greatly extend this capability. Computers with speed and storage roughly comparable to desktop computers of the late twentieth century are now commodities, miniaturised to a size somewhat smaller than a fingernail and currently costing roughly 50p (US$1) to £5 (US$10) in single quantities, and able to operate for days on small power cells. These work with similarly miniaturised sensors that can measure and record many details of a person's interaction with their environment and with other people. That could include proximity, motion, acceleration, rotation, skin temperature, brain and nerve activity, blood chemistry, and anything else that can be measured.

For example, presently researchers (and tourists) are using GPS technology in conjunction with digital photography and video to add spatial and temporal location to the mix of relationships that are recorded with the image (Fischer, 2003; also Happel, 2005). A researcher, camera or audio recorder is associated with a GPS device, which can inscribe location directly onto the media, or be associated after the fact by matching up times and locations with existing time stamps recorded in the media. The research day, week or season can be played back temporally and spatially (say on a map), evoking recorded media, notes and other time-stamped data that is associated with the researcher's presence (Fischer, 2006b).

In another recent example, Brown et al. (2005) recorded dance movements, which are then performed by computer avatars as the basis of interviews with people whose culture includes the dances, as a method for identifying the significant components of the dance.

Similarly, social networking is beginning to draw on sensor readings: for example, GPS functionality in photo tags that invoke Google Maps to display where the photo was taken, and Nike+ offering a running shoe that logs information regarding the run to an iPod Nano, which can then be uploaded to the Nike+ website (http://nikeplus.nike.com/nikeplus/) where runners can compare runs.

In other words, the trend is to increase our capacity to record much more of the research context and process, and this greatly expands the kinds of data we have accessible to us, including sensor data recorded by potential research subjects on their own initiative. Multi-megapixel photography and HD Video, combined with new, cheap, 360 × 180-degree lenses, already make it possible to visually record a complete scene, not just an aperture of a few degrees.

All this will, of course, create new issues in how to represent and use this staggering array of data. Conventional methods, such as statistical summarisation of particular views of the data, will of course continue to be used. But our approaches will be increasingly driven to disaggregated designs, where we build layers of abstraction and aggregation over the dataset while retaining the links to the underlying data. Some data will be real time streams, constantly generated by the activity of potential research subjects. If not 'on-line', data will increasingly be 'on-tap'. Research design will generally transcend towards disaggregation.

There are two basic issues that emerge in relating these capabilities to research methods. The ethical dimensions of research on this scale, which depends on near- or real time information relating directly to individuals, are vast, and we discuss them further in a later section. But an immediate question arises (as soon as we recover from chills at the thought of what ethically doubtful things researchers and non-researchers might/will do with this technology): 'What would we do with all that?' This is the larger point: at present the level of detail which can be collected is largely irrelevant to our research questions and research methods, and in many ways, beyond our conceptual capacity. So how might this be one of the futures we could build?

There are connections with existing research methodologies. Ethnographic studies, though usually on a smaller scale, have encompassed much larger communities by using a combination of immersive observation in sub-groups, whilst evaluating the results

of immersive observation through sampling the larger population (Moody and White, 2003; also Fischer, 2006c). Mass observation studies have made sense of the records of thousands of people's self-observation. Larson and Csikszentmihalyi (1983 – and see Csikszentmihalyi (1991)) – introduced 'beeper' technology to ground and contextualise the interactions of large research populations, with participants reporting activities under way when the beeper sounded. Each of these techniques seeks to impart meaning to the behaviours that can be observed.

At first blush it appears that all we get from the capability to access large sets of detailed data is a lot of behavioural data, with no meanings associated with that data. But because it is all disaggregated data, there are opportunities to do a great deal more. In the early days of research using satellite imagery a similar situation prevailed. There were many measurements of different aspects of an area, but researchers could not assess much more than what the measurements themselves entailed: how much light of different frequencies was reflected. To use this data for environmental research, research was done to examine the areas the images represented, producing low-level data on physical topography, plant cover, buildings, crops, fields, bodies of water, vehicles and other objects, which were then related to the imagery. The outcome of this process was to make it possible to identify with great accuracy those things that had been 'ground truthed' in other locations.

What will be needed is the development of 'proofing' subsets of the behavioural data, so that findings from the 'proofed' data can be extended to the larger set of observations. Methods for this purpose are under development, included broadly within the relatively new research activity of data mining (see Little and Schucking, this volume). Data mining depends on relating patterns in disaggregated data streams to knowledge about the processes that produce that data. So rather than a return to pure behaviourism for all social scientists, we can use the behavioural outcomes of ideationally driven processes as indices for identifying the likely presence of these same processes elsewhere.

This research methodology is in fact very similar to many present social science research perspectives. Some of us carry out small-scale ethnographic studies, or focus groups, or do sample surveys of some fragment of a population. We attempt to identify the social processes at work in these studies. We then attempt to generalise the results, based on ethnic or cultural group, social group, educational group, language group, etc. The principal difference here is that we are relating directly the patterns we observe and have 'proofed' to the larger population, not just through a few well-studied proxies.

New methods and means of representation and visualisation developed to support e-Science (Fielding, 2003), multi-agent based simulation, and virtual worlds such as Second Life will increase our capacity to work with multiple views of the disaggregated data (Bainbridge, 2007), enabling multiple research designs to be instantiated during, or even after, the data collection, the use of hybrid designs such as interactive dynamic statistical sampling, and composite representations that are 'layered' so that the original data is always available regardless of the level of abstraction (Fischer, 1998).

If the ethical issues can be resolved, with sufficient resources it becomes possible to track the movements and interactions, visual and aural context of an entire population. While presently ethically challenging, it could have a role, for example, in documenting complex public rituals or the range of day-to-day interaction between people in a community.

STORAGE

Recent developments in 'intelligent' machine data storage have produced conceptual tools which are certain to have an impact on the kinds of research social scientists are not only able to imagine, but indeed will be required

to conduct. The present model of storage has been to associate particular bits of information with particular places. The advent of Alta Vista and then Google demonstrates that this model has seen its day. There is simply too much information, in too many places, to organise using a simple set of addresses or locations.

One possibility is to access information based on its content (semantically) rather than its location. The idea of semantic or associative storage has a long history, indeed goes back to the visionary paper by Bush (1945). It was found in one of the earliest programming languages, Lisp (in 1958; see McCarthy, 1979), and has appeared recently in the Semantic Web (Fensel et al., 2002). The semantic storage concept goes beyond matching content, as with keywords or classifiers, but rather depends on a model of 'understanding' the content, and entailments of the content in different contexts.

Semantic storage systems enable software to infer meaning from data and relationships between data. There have been a number of increasingly sophisticated partial solutions to the problems, working around the fact that machines do not think as humans do; that is to say, that while a human with a reasonable search engine is capable of identifying related information across a range of websites, a machine is greatly handicapped by the ways in which such data is currently stored, largely because as yet we have not been able to model how we understand the content.

Most current solutions involve adding different kinds of metadata (what machines use to infer relationships) to the content, and this has made it possible to produce prototypical versions of a Semantic Web, in which a range of inferences may be generated automatically. At present there are limitations imposed by the absence of such metadata in most web repositories, as well as scalability problems (Owens, 2005). The scalability issue is sure to be resolved, but the cause for the absence of pervasive metadata on the web is probably not as easily addressed. Triples stores such as RDF and OWL web 'ontologies' (sic) are simply not, at present, designed with most social scientists (or many other categories of people for that matter) in mind. Part of the problem is the amount of specialist labour required to classify each online resource to fit the classification scheme that permits inference to take place (Brent, this volume, highlights this issue). This will change in part through the integration of social science knowledge of how people organise complex data. Kinship terminologies, for example, offer a very simple, yet very robust algebraic mechanism for ordering relationships of extremely large numbers of individual people (Read, 2006). Other sorts of indigenous taxonomic system used to order the natural world share similar properties of simplicity, with impressive scalability, which are, at present, arguably limited by aspects of human cognition other than the inference systems themselves. Greater inclusion of natural or evolved human systems of inferring relationships, we expect, will enhance the capacity of human users to make ever greater use of the vast array of complex data available. Indeed, we see evidence that such mechanisms for ordering relationships are already being successfully implemented in social networking sites in two ways. First, the sites ask users to classify friends according to a set of criteria, which will then enable relationships between friends of friends to emerge; second, friends in common automatically get highlighted, which enables a certain measure of the coherence of a given set of networks (see Hogan, this volume). Similarly, sites such as Flickr and Digg serve as an online folksonomy, where users create their own labels or 'tags' for images and web resources.

Folksonomy sites, where people are increasingly tagging most of what they create themselves in their own terms, combined with our own research on how people organise and use knowledge, should provide rich data for social science research AND have applications to creating the Semantic Web. At the end of this process we can look to having intelligent 'assistants' to help us identify and analyse data, rather than simple workstations on our desks.

SOCIAL CHANGE

The immediate basis for discussing possible social change is the example of the period from 1990 to 2007, much of which is discussed in this collection. We argue that the major driver of social change from IRCT is a trend towards pervasive communication. This trend is not confined to the Internet. Since 1990 e-mail has developed from a niche mode of communication for academics to a mainstream medium worldwide. In the developed world mobile phones, once mainly a source of irritation in restaurants and trains, have become essential for the young and many of their elders. Access to the Internet has changed from episodic connections using simple modems to pervasive connections via broadband, and a strong trend towards 'always-on' mobile connections.

In the developed world we already have the capacity for pervasive communication. We can phone, e-mail, instant message (IM) or text most of our social partners at any time, as can they. Our ways of interacting with each other are adapting rapidly, particularly among the young, whose opportunities for physical contact are becoming increasingly restricted. However, this is just the beginning.

Currently communication is dominated by written and spoken language, and to a limited extent images, still or animated. Although the episodic period is very much reduced there remains a socially imposed periodicity on communication. While the generations born prior to 1975 tend to regard privacy as an important element of their lives, those born since 1985 are much more apt to regard any aspect of their lives as public, though in their control. The rise of social sites in the period following 2002 has resulted in vast amounts of information about day-to-day private life being published on the Internet. In 1999 Scott McNealy, then CEO of Sun Microsystems, commented, 'You have zero privacy anyway. Get over it' (from Sprenger, 1999[2]). If the ethos of the 1960s was reflected in Andy Warhol's suggestion that everyone could have 'fifteen minutes of fame', by 2015 it may be radical to offer people 'fifteen minutes of anonymity.'

Since the appearance of the first webcam in 1993, hundreds of people have published their lives on the Internet. Increasingly individuals will use pervasive wireless networks to broadcast their day in progress, at least to what they perceive to be their social network. Conventions of management of image will evolve with both transmission and access to this information. It will not be a 'raw' transparent record, but another tool in presentation of self and of group.

The use of CCTV has expanded greatly in the period up to 2007, and is likely to continue. Countries like the UK have vast numbers of cameras covering city centres, shopping outlets, and – increasingly – residential streets. Plans to 'chip' vehicles, together with sensors in the roads, will track movements. Mobile phones can be tracked using either triangulation to transmitters or, increasingly, embedded GPS.

It is likely that over the next two decades more and more use of cameras, 'smart' ID cards, chipped pets, sensors, and peoples' own choices and interactions will be accessible online, and probably to a large extent publicly, so that 'privacy' groups may force public access as the only solution to protecting people from specialist government and commercial surveillance, transforming a threat to a resource that will modify social relations. The point of this scenario (nightmarish to those born before 1975) with respect to both online research and social science research in general is that more and more information will be available to us, and that our potential research subjects will themselves be using this information as a part of forming their own lives, and thus of the meanings that they manage. Increasingly these relationships will be conducted and managed online.

VIRTUAL AND TEMPORARY COMMUNITIES

One outcome that should emerge from this increasing capacity to 'know' people from

their online presence is a great realignment of how people manage social relationships. Robin Dunbar argues that individual people can efficiently manage social relationships based on personal knowledge in relatively small numbers, about 150–200 in total (Dunbar, 1993). Though we might want to quibble on the actual value, numbers of at most a few hundreds are consistent with most studies of personal networks and ethnographic accounts.

People faced with this much information, on so many people, could be expected to either substitute 'virtual' relationships for locally situated relationships, or to develop culturally acceptable technological aids to managing more relationships, as has been the long-standing practice of salesfolk, account managers and ethnographers.

The study of online communities and distributed communities that rely on IRCT to maintain social cohesion is well under way. Clearly such studies exist and are set to grow. Castells (1996; 1997; 1998) refers to real virtuality, as opposed to virtual reality; by that he means the virtual space which becomes as real, and integral, to people's lives as more traditionally recognisable realities. As individuals turn more to the Internet to play a significant role in their sociality, so too will social scientists need to devote time and energy to understanding the contrasts and continuities between these types of sociality and others. For example, special-interest online communities, in which the individuals make use of avatars as self representations, begin to provide some of the missing body language that face-time offers. Some online groups have developed alphanumeric coding systems to give clues that might otherwise have been projected through the use of facial or body gestures. The elaborated alphanumeric codes express at least some of the information that would be immediately apparent in a face-to-face meeting. The Geek Code (http://www.geekcode.com/geek.html) has a category to indicate the type of clothing a person usually wears (conservative, punk, casual jeans, etc.), as well as sexual goals or history (at least some of which might usually be conveyed indirectly through body-language flirtation). Similarly the Furry Code (http://captainpackrat.com/furry/furcode.htm) provides abundant information about the animal with which the individual 'furry' identifies, and whether or not they are interested in pursuing romantic, platonic or bestial sexual relations (pardon the pun).

The point is that, across the Internet, cyber communities are cropping up and creating ways to fill in the gaps of online sociality and render it increasingly 'real'. For the moment this is largely of interest to social scientists interested in studying fetish groups or marginalised groups who for one reason or another find it difficult or impossible to be more open in their community activities, but the techniques for overcoming the impersonal nature of socialising developed in these forums will spread and become simpler and easier to implement and interpret. Think about the evolution of emoticons from the ASCII days to the graphical versions of almost all IM services today, and it is not hard to imagine the complexity of the Geek Code or the Furry Code being quickly renderable into simpler graphics conveying the range of information that one might instantly identify in face-to-face meetings.

Developments such as these lead us to support the view that much of the present focus on 'virtual relationships' should be seen as a variation of 'actual' social relationships. These relationships are not virtual, and indeed it is likely that social relationships in the future will be based on more 'real' information than at present. This is likely to lead to great friction between generations over the next few decades. However, the obsession of governments with collecting information about their citizenry will offset this considerably. In any case the boot-strapping process for children and young people transforming the 'virtual community' into 'community' is already well established.

TEMPORARY COMMUNITIES

Temporary communities offer a number of opportunities for social scientists.

When people come together for a common cause, motivated by interests which have, to some extent, built-in expiry dates, it becomes possible to observe conscious community-building techniques. Many of these will fail, because the people involved have never seriously tried to understand what makes communities remain cohesive through differences of opinion, disagreements about resource allocation and the host of other incidents that arise and cause people to decide they would be better off either with another group or on their own. Primate and hunter-gatherer populations demonstrate the propensity of small groups to have very fluid group composition and to break up and rejoin frequently. With sedentarisation comes the need for more complex mechanisms for conflict resolution and negotiation. Interestingly, the kinds of special-interest community made possible by IRCT may need far simpler and less robust conflict-resolution mechanisms, because the scope of interaction is highly restricted. Moveon.org had effectively developed an online movement more or less in opposition to George Bush and the War on Terror. It is almost inconceivable that all the members of Moveon.org would cooperate well in face-to-face settings, and even less likely that they would agree on all the major issues in foreign policy confronting the US and the UK.

Nevertheless, in a sense such a movement is evidence of IRCT's ability to foster temporary communities around restricted sets of issues. The communities need not be tested in the way residential neighbourhoods might be, because one will never be confronted with the reality that one's community fellows in fact are selfish, or xenophobic on some issues, or sexist or racist in some ways. To some extent, the members may imbue other members with agreeable characteristics, using the logic that if someone is against the War on Terror, or does not care for George Bush as president of the United States of America, then he or she must also agree with me on X, Y or Z. Using such logic, it becomes possible to create very powerful online communities with limited capacity for longevity. When George Bush is no longer president and the War on Terror fades or is declared over, then many such movements will disappear as well. Much as the war protests against Vietnam created odd bedfellows in the United States, so too can opposition to global events create unusual coalitions of individuals. What makes these interesting, and possibly the result of a kind of IRCT revolution, is their globality. Apart from the fact that the most widespread of such temporary communities use English as their language of communication, they bring together the IRCT-savvy individuals from literally around the world. We expect that such temporary communities will rise and fall with increasing rapidity, and that one of the areas of social science investigation will be when and where such communities arise and why. Clearly not all the actions of global capitalism have provoked successful temporary resistance communities, despite the fact that some individuals will almost certainly try, so it will be the task of social scientists to try and identify possible causes for success or failure of such groups.

CHANGE IN ETHICAL STANDARDS

A lot of what we discuss may be very ethically challenging for some current social scientists. Having increased social scientists' awareness of ethical standards over the latter half of the twentieth century, over the next decade or so it is likely that ethical attitudes, and thus ethical standards, will change substantially. Particularly, what are now considered privacy and disclosure issues will undergo significant change. It is already clear that social scientists' attitudes towards privacy are lagging well behind much of the public's attitudes with respect to what is and is not suitable for public consumption. It is not that ethical principles will change (though they might), but that the interpretation of principles into behaviours can and will, if the current set of interpreted behaviours becomes sufficiently 'de-linked' from basic ethical principles. The purpose of ethical research standards is not to define ethics, but to identify behaviours and situations that may

be ethically harmful or dangerous. This is generally implemented by creating checklists of things that must and must not be done (or must be well justified), and individual projects are considered by review panels to reach a view of the potential harm posed by the project. Most panel judgements are not that the research is unethical, but that there is a substantial danger that harmful or unethical behaviour could result from undertaking the research.

The growth of 'reality TV' has greatly extended from 'hidden camera' gag shows, 'fly on the wall' documentaries and game shows to situations that would be considered a morass of ethical issues in a research project. An example is the UK reality series 'Big Brother', where individuals are confined to a living space and continuously recorded, food and drink withheld, and conflict encouraged. A Dutch reality TV series in 2007 pretended to pit people needing a kidney transplant against each other to compete for the kidney of another participant, a woman with a terminal disease. Although in the end the show was revealed to be a partial hoax, the potential kidney recipients were genuinely in need of kidney transplants, and prior to this revelation the show was widely discussed in the mass media, which accepted the scenario at face value (though not, generally, approvingly).

Young (and not so young) people are choosing to share parts of their life online using capabilities from social technologies such as blogs, chat rooms and social portals. And they are sharing other people's work as well. The whole framework of so-called 'rights management' of intellectual property is being challenged, immediately following successful lobbying by the industry to shore up the legal restrictions on distribution. But this is an example where legality and ethics do not precisely correspond in the minds of many people. At the same time, many social scientists and cultural activists have been attempting to strengthen the claims of indigenous peoples to their own cultural productions by bringing these into intellectual property frameworks. It is likely that they also will be forced to consider other models, just as the entertainment industry is, probably focusing on providing additional services or value with regard to intellectual property, rather than controlling the 'property' itself or by associating material cultural property with the intellectual property.

While some social scientists engage in deep 'conversations' about the indirect dangers of the smallest change or alteration in someone's way of life, the society around us is tolerating, if not promoting, ever-escalating, hair-raising contexts as entertainment. And as the attitudes in our culture and society shift and privacy is redefined (never eliminated), we can expect our own ethical attitudes to change, and with them the ethical standards of research which are intended to satisfy our, and others', ethical attitudes.

This is not unprecedented. The history of universal human rights, from which present ethical standards for research have evolved, has taken many turns. The Universal Declaration of Human Rights in 1948 was one of the first to explicitly relate to research. Since that time the extent and coverage has broadened substantially, driven by human rights campaigners from North America and Europe. Engle (2003) relates the discomfort that many anthropologists had with the Declaration at the time, finding it difficult to reconcile ethically the developed world dictating the content of human rights for all societies and cultures. We can expect further change in the future, but we believe it is likely that new priorities will be identified, in particular with respect to privacy and what constitutes consent. We should add that we do not particularly welcome these changes, but find it hard to accept that, while public conceptions of privacy change, and governments expand their own data on their citizens, social scientists will cling on to a vision that no one else accepts. How standards will change and what the consequences will be are unknown, but we think we can be sure they will change.

With respect to privacy, much will hinge on how people come to view the increasing

surveillance of their lives. The evidence for this is not consistent. Certainly in the case of physical data and samples, such as DNA databases, clinical blood samples taken for a particular purpose, and human remains, attitudes appear to be hardening. Only DNA appears to be going the way of broader storage and use, not so much because people approve, but because Government appears dedicated to developing this resource.

In the case of data derived from observation and artefacts there is a much more ambivalent situation, where some people appear to accept this for security purposes, and others are very much opposed. However, the direction, as discussed above, appears to increasingly regard observations of public life as tolerable, if not acceptable, activity. And the means for keeping ear and eye on each other are by no means restricted to government.

For example, there are already tens of thousands of 'webcams' available online.[3] Many of these are continuous video links. This makes it possible to conduct a number of potential observational research projects around the world from a single location. While there may be many operational problems with research based on such methods, it is also clear that informed consent cannot be obtained. Indeed many of the people observed may be entirely unaware of their image being available to anyone with a fast Internet connection. Is it ethical to do certain kinds of research based on this resource, which is there regardless of whether we undertake research, or not? If we decide it is, is it still so if we commission the camera?

Similarly, through satellite and aerial images, now widely available through Google Maps, we can observe a great deal about communities. For example, the images for many communities are sufficiently detailed that we could easily do a survey of how people use and develop their back gardens.

The essential issue is that increasingly information about people will become available online. We are each, in our respective research communities, going to have to arrive at decisions about what we can and cannot use ethically in our research.

COMPLEXITY

It is clear that those social scientists who take up the challenge of dipping into this vast vortex of data will require methods that are different from the norm today. The foundation for appropriate methods is already being developed by social scientists, including the contributors to this volume, and others who are adapting research methods from the physical sciences trading under the 'Complex Systems' label (HCS UCLA; Santa Fe). Basically the complex systems approach represents a union between small-group or individual studies producing disaggregated research, and large aggregated studies that have typically depended on mathematical summarisation. The basic idea underlying research involving complex systems is that most social phenomena 'emerge' from the interaction of individuals and their contexts, which are ever-changing because of the actions of individuals and the emergent nature of social phenomena.

The complex systems approach crosses most of the traditional divides that have developed in the social sciences: it is both reductionist and non-reductionist, aggregated and disaggregated, symbolic and material, macro and micro, formal and informal. The area is also fiercely interdisciplinary and multi-disciplinary. Research methods depend on collecting data and representing explicitly and individually all the agents in a process, usually heterogeneous agents who all have their individual properties as well as their discrete representation. Agents may be represented by a few heterogeneous features or variables, or with a great deal of fidelity. Examples of this approach in social science have included studies of crowd behaviour, drug addiction (Agar, 2005), pastoral nomads (Kuznar, 2006; White, 2005), agricultural change (Fischer, 2001), and social change in institutions (Fischer, 2006). Even where there are small numbers of heterogeneous agents, the complexity of creating models where the phenomena under study can emerge generally requires computing support. Larger models challenge the capacity of high performance

computing, requiring facilities similar to those required by astronomers who model galaxies and physicists who model entire atmospheres, molecule by molecule.

Although the study of Human Complex Systems under the complexity/emergence paradigm is still in its early days, this would appear to be an appropriate way to utilise the greater volume of data we anticipate within the socially more complex formations we expect to form. However, the techniques being developed, the cyber-infrastructure that will be developed to accommodate this research, and the issues that will emerge from this research should not, and will not, replace existing approaches to research. Nevertheless, even 'conventional' research methods will be adapted with respect to the scope of data used, matching small case results to large-scale databases, incorporating advances in theory that emerge, and determining how to adaptively use new techniques such as agent-based modelling and data mining, which also represent viable approaches to working with large amounts of continuous data (see Little and Schucking, this volume).

CONCLUSION

On the one hand, much of what we have 'predicted' is in fact already possible and already being done – but only in small numbers and by a relatively computer-savvy elite/minority. Our contention is that software tools will get easier to use, so need no longer be the exclusive domain of a technological elite, and that the network society is an increasingly pervasive reality that social scientists will not be able (or want) to ignore. The information society is either around the corner, or we are already in the middle of it. Perhaps we will know which in ten years' time; but we can be certain that whether it is here now or just imminent, the world has changed from twenty years ago. Alvin Toffler's *Future Shock* articulated what life-as-normal was to be for all of us from now on. It is no longer just the baby-boomers who are lost in the world they have found as adults – it would appear that every generation is doomed to look back on the childhood world and wonder where it went. The flow of information and capital has introduced a greater demand for resilience and flexibility and a willingness, or at least an ability, to re-form oneself and one's community attachments based on a shifting set of contingencies. While the likes of Castells and Frank Webster perceptively recognised the broad strokes of such a transformation in the 1990s (and even, to a lesser extent Daniel Bell in his post-industrial society formulation of the early 1970s), it remains the task of social scientists to put the empirical flesh on the bones of such grand social theory and to identify specific mechanisms for coping with such a shifting and uncertain dynamism at the level of real individuals and real communities, either virtually real or really real.

NOTES

1 By fundamental we mean a new ideational insight and/or any consequent material capabilities we gain from this. For example, hypertext, conceived by Bush in 1945, implemented in part mechanically by 1965, implemented on computers by the early 1980s, fully integrated with networks in 1990 by Tim Berners-Lee in the first web server.

2 Polly Sprenger, Sun on Privacy: 'Get Over It', 26-1-21 999, Wired http://www.wired.com/politics/law/news/1999/01/17538. Accessed 2-5-2007.

3 For examples see http://www.webcam-index.com/ and http://www.earthcam.com/ (accessed 25 March 2008).

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A brief history organised around four aspects: technological evolution; operations and management; social aspect; commercialisation aspect.